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鲈形目少鳞鳜属(*Coreoperca*)化石在中国的首次发现[1)]

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摘要 记述的山东少鳞鳜(新种)(*Coreoperca shandongensis* sp.nov)是该属化石在我国的首次发现,标本产自山东山旺早中新世晚期山旺组纹层状硅藻页岩之上的含硅藻泥页岩中。山东少鳞鳜的发现,说明原始鳜类在中新世已发生分化,在中新世时期的中国大陆和日本列岛均已相当繁盛。少鳞鳜属可能并非起源于朝鲜和日本一带,之后扩散到中国,而是中新世广布于东亚的鱼类,这进一步支持了关于中国东部和日本列岛新生代晚期同属一个鱼类区系的观点。

关键词 山东山旺,早中新世晚期,鲈形目,少鳞鳜属

中图法分类号 Q915.862

山东山旺中新世鱼类化石最早由杨钟健、张春霖(1936)作了描述,后由周家健(1990,1992)重新采集和研究,共计有鲤科化石6属9种,鳅科化石1属1种。此地点的鲈形目化石尚属首次报道。以往我国仅在山西榆社上新世地层中记述过鲈形目鳜类中的鳜属(*Siniperca*)化石(Liu and Su, 1962),本文描述的少鳞鳜属(*Coreoperca*)化石在我国以前未见有报道。本文研究的标本是由第一作者于1996年10月采集,虽然标本欠完整,但数量较多,多数特征仍然可以在不同的标本上观察到。由于鲈形目鳜类的现生种仅分布于中国、日本、朝鲜和越南,物种分化较多,但化石报道却非常少,因此,山旺中新世少鳞鳜属化石的发现不仅为探讨低等鲈类的相互关系和物种的分化提供了新的资料,而且对东亚淡水鱼类起源和古地理环境变迁的研究均有着重要的意义。

1 系统描述

鲈超目 Percomorpha Rosen, 1973

鲈形目 Perciformes Regan, 1913

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亚目及科未定 Suborder and Family indet.

少鳞鳜属 *Coreoperca* Herzenstein, 1896

山东少鳞鳜 *Coreoperca shandongensis* sp.nov.

(图 1～10; 图版 I～III)

产地、层位及时代　山东临朐，山旺组，早中新世晚期。

正型标本　一条较完整的鱼，仅尾鳍后部缺失。中国科学院古脊椎动物与古人类研究所标本登记号：V 11523.1。

其他材料　计有较完整鱼体 2 件(V 11523.2～3)，保存了部分鱼体或重要零散骨片的标本 15 件(V 11523.4～18)。

词源　shandong，化石产地山东省的名称。

种征　背鳍前骨式 0/0/0+2/，背鳍式 XII，13；臀鳍条多数为 9 根，少数为 10 根；匙骨后缘光滑无锯齿；角舌骨上边缘有细长形窗孔；主鳃盖骨后缘两枚大小相仿的扁棘，上边缘隆起为弧形；前鳃盖骨后下角及下缘锯齿强壮而不甚规则，呈弱棘状，棘上分布有数目不等的小锯齿；间鳃盖骨下表面及边缘有细的粗糙突起；下鳃盖骨和间鳃盖骨下边缘均有弱锯齿；顶骨近不等边梯形，宽大于长；脊椎骨 30 个。

标本描述　一中等大小鱼类(图 1)，已采得 3 尾较完整标本，体长约在 104～115mm 之间，体宽，侧扁，头长，眼眶大，口裂大，最大体高位于背鳍起点处或稍后，体长为体高的 2.9～3.0 倍，为头长的 2.5～2.6 倍，为头高的 3.2～3.3 倍，为尾柄长的 5.5～6.3 倍，为尾柄高的 6.9～9.5 倍；头长为吻长的 3.8～5.3 倍，为眶径的 4.2～6.1 倍；尾柄长为尾柄高的 1.1～1.7 倍。

标本测量 V 11523.2	(mm)
体长 body length	104.4
体高 body depth	34.6
头长 head length	42.5
头高 head depth	31.5
眶径 orbit length	8.1
吻长 snout length	11.1
眶后头长 postorbital head length	21.9
尾柄长 peduncle length	16.7
尾柄高 peduncle depth	15.2
背鳍棘基长 dorsal spine base length	29.1
背鳍条基长 dorsal soft ray base length	21.6
臀鳍基长 anal fin base length	12.4
背鳍起点至吻端距 distance from the origin of dorsal fin to the rostral extremity	42.4
背鳍起点至尾鳍基距 distance from the origin of dorsal fin to the caudal fin base	58.3

头骨：头大，头长为头高的 1.3～1.4 倍。

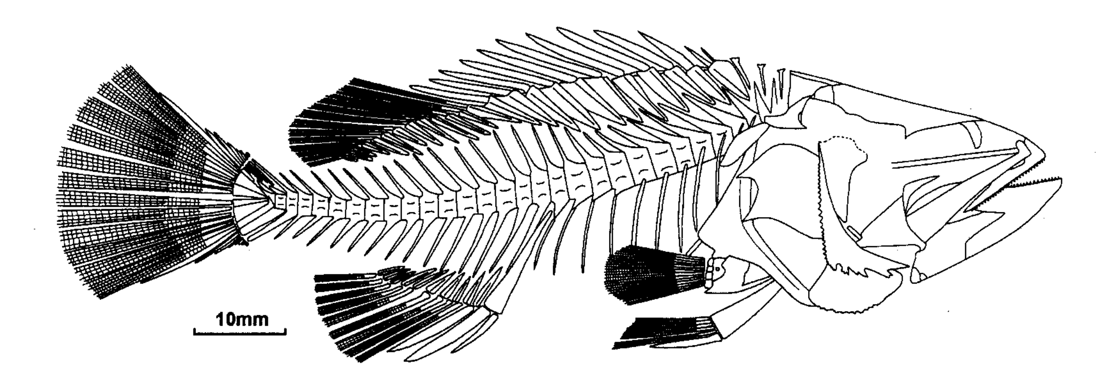


图1 山东少鳞鳜(新种)复原图
(据标本V 11523.17, V 11523.1, V 11523.4, V 11523.7, V 11523.9)
Fig.1 Restoration of *Coreoperca shandongensis* sp. nov., right lateral view

脑颅：多数标本颅顶保存不好，只在V 11523.10和V 11523.9标本可分辨出额骨和顶骨位置。额骨占有大部分颅顶面积，表面光滑，前部稍窄，前2/5的外侧缘向里凹陷，构成眼眶上部，后外缘接蝶耳骨和翼耳骨，自其前端至后外侧有眶上感觉管穿过；顶骨较小，形状近似不等边梯形，与上枕骨两侧及前面的顶骨在同一平面形成一平整的区域，宽大于长，顶部中间微下凹(图2)。上枕骨已破损，前端尖锐，分开二顶骨插入二额骨中间，有向后突出的高耸的上枕嵴，嵴的上缘加厚，腹部薄，在V 11523.11标本可见上枕骨骨架痕迹，无法判断上枕骨骨架与上枕嵴上边缘是否为深叉状。二额骨前方有中筛骨插入其间，其形状在V 11523.8标本上较明显，侧视呈"厂"字形，"厂"的拐角处有两个向前上方的小突起，与前上颌骨的上升突关节。鼻骨未能保存。中筛骨下方两侧还有较厚的侧筛骨，由于挤压变形，其形状已无法辨认，其上边缘与额骨相接，后侧缘构成眼眶的一部分。眼眶较大，眶径略小于眶前距，围眶骨系列未能保存。副蝶骨较粗壮，贯穿眼眶下部。眼窝的后上部、脑颅的内部隐约可见片状的翼蝶骨；在脑颅的中部、翼蝶骨的外侧可见蝶耳骨，蝶耳骨背上方与额骨相接，后部接翼耳骨，外侧中间有一突起，腹后侧连接舌颌骨和翼耳骨。翼耳骨因残破已无法辨认其形状。上耳骨已破碎，仅见一突起并为后颞骨所覆盖。后颞骨向前伸出两支，背支附于上耳骨突起上，腹支已破碎，后端光滑。侧枕骨和基枕骨形态均已观察不清。

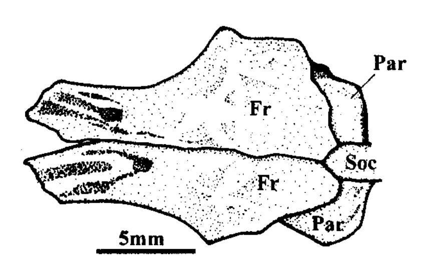


图2 山东少鳞鳜额骨和顶骨背视(V 11523.10)
Fig.2 Frontal, parietal and supraoccipital of *Coreoperca shandongensis* sp. nov., dorsal view
额骨(Fr) frontal, 顶骨(Par) parietal, 上枕骨(Soc) supraoccipital

颌部：口裂大，下颌与方骨关节处几达眼眶后缘。口缘由前上颌骨和齿骨组成。前上颌骨前端有一向上的细长上升突起(ascending process)，和中筛骨的突起相贴，其侧方为略宽而短的关节突(articular process)，上端圆，和上颌骨前叉的凹面关节；前上颌骨中间

有一向后上方的片状突起(post-premaxillar process)，前上颌骨口缘有绒毛状齿组成的齿带。上颌骨在前上颌骨后方，略呈弧形，后部宽而扁平，前部变窄，前端为分叉的关节突，凹面承接前上颌骨的关节突，其后为腭骨的前方突起。在V 11523.5标本上颌骨后上方可见一细长条形的辅上颌骨。齿骨略呈三角形，硕厚，口缘有绒毛状齿，后端分叉，为关节骨插入处。关节骨硕厚，呈三尖两叉形，中间的尖突最长，插入齿骨后凹中，下面的尖突抵齿骨的后边缘，上面的尖突为上颌骨所遮盖，后背方有和方骨关节的关节窝，后下方有两块小的隅骨(见图3)。

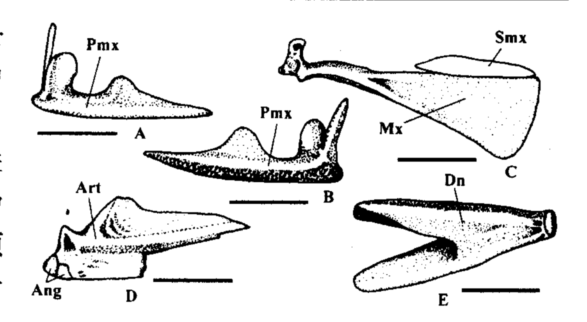


图3 山东少鳞鳜颌骨

Fig.3 Jaw bones of *Coreoperca shandongensis* sp. nov.

A.左前上颌骨(Pmx)外侧视 left premaxilla, lateral view(V 11523.11)； B.左前上颌骨(Pmx)舌侧视 left premaxilla, lingual view (V 11523.10)； C.右上颌骨(Mx)和辅上颌骨(Smx)舌侧视 right premaxilla and supramaxilla, lingual view (V 11523.5)； D.右关节骨(Art)和隅骨(Ang)外侧视 right articular and angulars, lateral view (V 11523.6)； E.左齿骨(Dn)舌侧视 left dentary, lingual view(V 11523.9)；比例尺(scale bars) 5mm

腭部：在多数标本上均未观察到腭骨，仅在V 11523.12标本外翼骨的下方见一稍扁的棒状细条，腹面具绒毛状细齿，前面部分已破损，推测应为腭骨。内翼骨为长半椭圆形，背缘接近副蝶骨，后外缘接后翼骨。外翼骨为直角的弓形，背缘接内翼骨，后缘接方骨。方骨呈三角形，下缘加厚，前下方有关节突和关节骨的关节窝相关节，细长的续骨自方骨后缘下方插入(图4)。方骨后上方、内翼骨后下方为薄片状的后翼骨，形状不清。

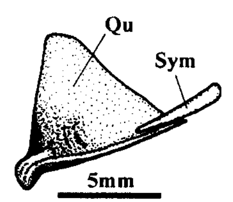


图4 山东少鳞鳜方骨(Qu)和续骨(Sym)侧视(V 11523.10)

Fig.4 Quadrate and symplectic of *Coreoperca shandongensis* sp. nov., lateral view

颊部：多数标本均未能保存围眶骨，仅在V 11523.1标本副蝶骨之上、侧筛骨之后见有泪骨残痕。鳃盖骨近似梯形，前缘加厚，后缘有二扁棘，大小相仿或下棘仅略大于上棘，上边缘呈弧形。前鳃盖骨上、下支相交呈直角，上支远长于下支，沿着前鳃盖骨的中线有突起的嵴，上支后缘有细的锯齿，上支拐角处至下支下缘的锯齿强壮而不甚规则，呈弱棘状，棘上又不同程度地分布有数目不等的细齿。下鳃盖骨为前宽后窄的长条形骨片，前上方有一细长突起，插入鳃盖骨和间鳃盖骨之间(V 11523.9)，下鳃盖骨的下缘也有弱锯齿，锯缘较宽。间鳃盖骨呈长椭圆形，薄片状，下边缘表面有细的粗糙突起，呈弱锯齿状(见图5)。

舌弓、鳃弓及鳃条骨：舌弓骨骼在多数标本上均未观察到，舌颌骨仅在V 11523.8标本上保存较好，上端扩大，下端为柄状突起，夹于后翼骨和前鳃盖骨之间，上端后缘已破损，舌颌骨外侧中间有突起。基舌骨位于口腔底部，为一扁平长条形小骨，前端游离，后端与下舌骨相接(V 11523.16)。在V 11523.7标本上可见部分角舌骨，在V 11523.5标本上

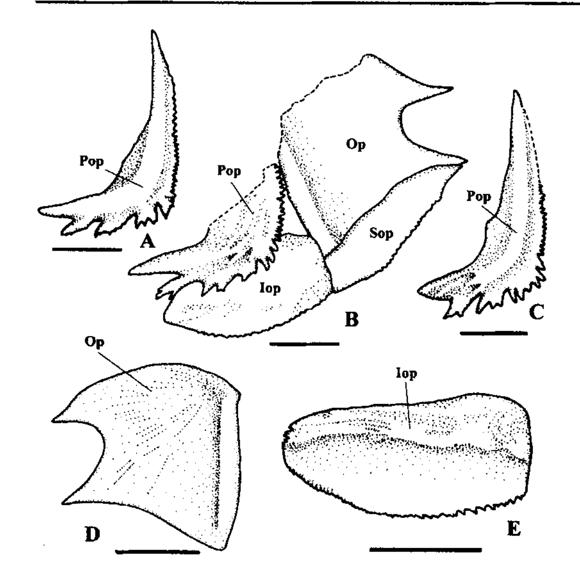


图 5 山东少鳞鳜鳃盖骨系列

Fig.5 Opercular series of *Coreoperca shandongensis* sp. nov.

A.左前鳃盖骨(Pop)侧视 left preopercular, lateral view (V 11523.9); B.左主鳃盖骨(Op)、前鳃盖骨(Pop)、下鳃盖骨(Sop)和间鳃盖骨(Iop)侧视 left opercular, preopcular, subopercular and interopercular, lateral view (V 11523.1); C.左前鳃盖骨(Pop)侧视 left opercular, lateral view (V 11523.8); D.右主鳃盖骨(Op)侧视 right opercular, lateral view (V 11523.18); E.左间鳃盖骨(Iop)侧视 left interopercular, lateral view (V 11523.14); 比例尺(scale bars)5mm

可见分散保存的上舌骨、角舌骨和下舌骨，上舌骨呈扁平三角形，前端宽大，和角舌骨相缝合；下舌骨二块，与角舌骨前方相联，形状不清。角舌骨在V 11523.10标本中保存较好，扁平长形，两端宽，在背缘内侧中间见有一细长窗孔，应是金眼鲷孔(berycoid foramen)(图6)。在V 11523.10标本见一与上舌骨末端相联的细棒状骨片，推测应为茎舌骨。尾舌骨和鳃弓骨骼均未能保存。鳃条骨7根。

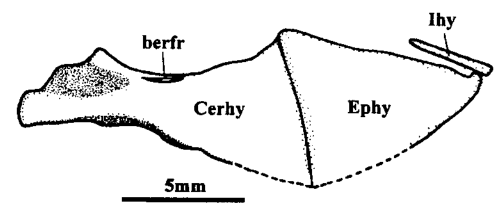


图 6 山东少鳞鳜角舌骨、上舌骨和茎舌骨 (V 11523.10)

Fig.6 Ceratohyal, epihyal and interhyal of *Coreoperca shandongensis* sp. nov.

右角舌骨(Cerhy)，上舌骨(Ephy)和茎舌骨(Ihy)舌侧视 right ceratohyal, epihyal and interhyal, lingual view, 金眼鲷孔(berfr) berycoid foramen

肩带与鳍：上匙骨在V 11523.3标本上可见一破损的残片，前端狭窄，后端扩大为椭圆形薄片。匙骨长大，弯曲，上端为上匙骨遮盖，拐角处向后伸展出宽平骨片，腹支长，略向前下方延伸。后匙骨2呈棒状，紧贴后匙骨1下方，两者均已有些错位。肩胛骨由于挤压变形，形状不清；乌喙骨位于肩胛骨和匙骨之下，略似斧形，与肩胛骨、匙骨连接的一端扩大，向前延伸的一端缩小为柄状(图7)。胸鳍位低，起点与背鳍起点相对，鳍条约13～15(16?)根，胸鳍基部有4块短棒状的支鳍骨(radials)，在V 11523.3标本上可见3块连于肩胛骨边缘，一块连于肩胛骨和乌喙骨交接的骨缝处。腹鳍胸位，起点略后于背鳍起点和胸鳍起点，直接关节于一对相连的无名骨(innominatum)上，无名骨前端三棱形插入匙骨腹枝近末端处，后端增厚(V 11523.16)(图8)，在V 11523.9标本上见有较长的腹鳍后突(postpelvic process)，左右愈合较好。腹鳍具1根粗壮鳍棘及5根鳍条。

背鳍长，分鳍棘和鳍条两部分，鳍棘部分和鳍条部分连续，鳍棘部分基部长于鳍条部分基部；背鳍式为XII,13，第1根鳍棘最短小，第2根次之，之后逐渐增长，至第6、7根最

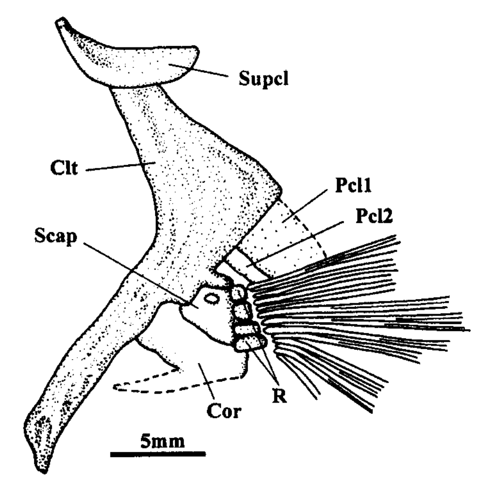


图 7　山东少鳞鳜肩带(V 11523.3)
Fig.7　Pectoral girdle of *Coreoperca shandongensis* sp. nov.
左上匙骨(Supcl)，匙骨(Clt)，后匙骨(Pcl1, Pcl2)，肩胛骨(Scap)，乌喙骨(Cor)和支鳍骨(R)侧视　left supracleithrum, cleithrum, postcleithrums, scapula, coracoid and radials, lateral view

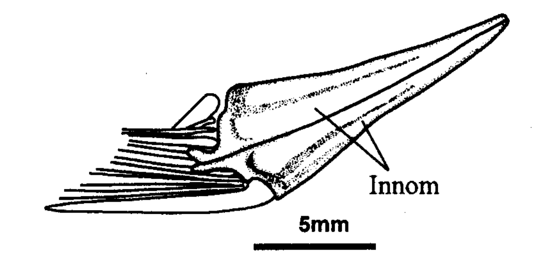


图8　山东少鳞鳜腰带 (V 11523.16)
Fig.8　Pelvic girdle of *Coreoperca shandongensis* sp. nov.
无名骨(Innom)舌侧视innominatum, lingual view

长，其后鳍棘长度依次略递减，最末 1 根鳍棘与第 4 根鳍棘近等长；在鳍棘的支鳍骨前有 3 块小的背鳍前骨(predorsal bone)，背鳍前骨由第一、第二椎骨的髓棘间开，背鳍前骨式[1)] (predorsal formula,据Ahlstrom *et al.* 1976)为 0/0/0+2/，即第一背鳍前骨位于第一躯椎神经棘之前，第二背鳍前骨位于第一、第二躯椎神经棘之间，第三背鳍前骨和第一背鳍支持骨同位于第二和第三椎骨的髓棘之间；第一背鳍支持骨支持二根鳍棘，其余支鳍骨上均只有一根鳍棘；鳍条部分的支鳍骨相对弱些。

臀鳍基短，起点略后于背鳍软鳍部分起点。鳍式为Ⅲ，9–10，第一鳍棘最短小，其余二鳍棘粗壮；第一支鳍骨长大，留有二根支鳍骨愈合的痕迹，可延伸至脊柱附近，并支持二根鳍棘(V 11523.7)。

多数标本尾鳍均未保存，仅在 V 11523.2、V 11523.3 和 V 11523.5 标本上保存稍好，尾鳍圆形，鳍式为Ⅰ，8，7，Ⅰ；尾鳍上下主鳍条外侧各有短鳍条(procurrent ray) 8 根。

脊柱：脊椎骨 30 个，其中躯椎 13 个，尾椎 17 个；最前 2 个躯椎的髓弓上附有 2 根比普通腹肋细小的骨条，应为上髓弓小骨(epineural)，第三躯椎之后的几个躯椎的腹肋(pleural rib)上附有细小的上肋(epipleural)，末端不分叉；腹肋较粗壮，共有 11 对(V 11523.16)；最后 3 个躯椎的腹肋上未见有上肋，椎体上有明显的椎体横突(parapophysis)。从保存较好的 V 11523.15～17 标本来看，尾部骨骼为低等鲈形目鱼类中常见的型式(图 9)，第一尾前椎(PU_1)和第一末端尾椎(U_1)愈合为三角形椎体，无独立的第二末端尾椎(U_2)；尾神经骨(UN) 2 枚，第一尾神经骨下部扩大成尾盖骨(stegural)；尾下骨(hypurals) 5 枚；副尾下骨(parhypural)及第 1～2 尾下骨与尾鳍下叶鳍条相连，第 3～5 尾下骨与尾鳍上叶鳍条相连；第 1～4 尾下骨均扩大，扁平，第 5 尾下骨细小，呈楔形；尾上骨(epurals) 3 枚。第二尾前椎(PU_2)的脉棘变宽呈板状，第三尾前椎(PU_3)的脉棘也略变宽。

1) 公式中0代表背鳍前骨，/代表躯椎神经棘，数字代表第一支鳍骨所支持的鳍棘或鳍条数目。

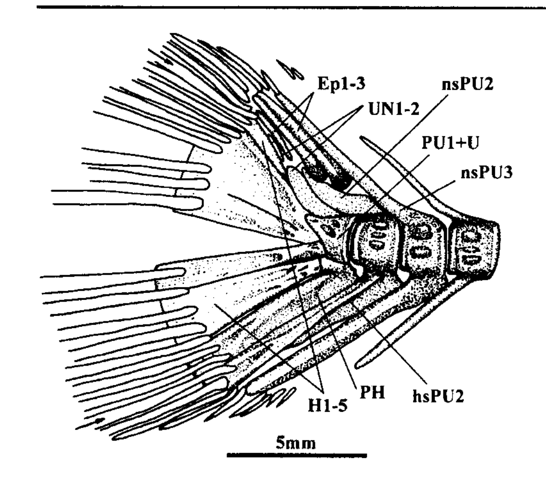


图 9 山东少鳞鳜尾骨骼(V 11523.15)
Fig.9 Caudal skeleton of *Coreoperca shandongensis* sp. nov.
尾上骨(Ep)epural,尾下骨(H)hypural,第二尾前椎脉棘($hsPU_2$) haemal spine of PU_2,第二尾前椎神经棘($nsPU_2$) neural spine of PU_2,第三尾前椎神经棘($nsPU_3$) neural spine of PU_3,副尾下骨(PH) parhypural,尾前椎(PU)preural centra,末端尾椎(U) ural centra,尾神经骨(UN)uroneural

鳞片:在多数标本上均未观察到鳞片,可能与化石的埋藏及修理情况有关,仅在V 11523.13标本的匙骨、躯尾的极个别部位隐约可辨认出细小的鳞片,为圆鳞。

2 比较和讨论

鳜类是鲈形目中的一群淡水鱼类,以体被圆鳞,头顶从前端到顶骨区裸露无鳞,尾鳍圆形,角舌骨上边缘凹陷或两端向中间延伸封闭成窗孔等为离征组成的一单源群(Liu and Chen, 1994)。由于低等鲈形目鱼类属种特征存在较大变异,对于鳜类属的划分至今仍存在多种不同的意见。Gill(1862)以 *Perca chuatsi* 为模式建立了鳜属(*Siniperca*), Herzenstein(1896)以 *Coreoperca herzi* 为模式建立了少鳞鳜属(*Coreoperca*)(Fang & Chong, 1932)。方柄文等(1932)以 *Siniperca roulei* Wu为模式种建立了 *Coreosiniperca* 属。朱元鼎(1985)和周才武等(1988)都将鳜类分为三属;刘焕章等(1994)依据鳜类的系统发育研究结果,确定为二属,即 *Siniperca* 和 *Coreoperca*,将 *Coreosiniperca* 并入 *Siniperca* 属。

由于化石属种的研究往往须依据现生鱼类作参考,因此,本次研究专门重新剥制了现生 *Siniperca chuatsi* 骨骼标本,并与现生 *Coreoperca kawamebari* 骨骼标本进行了详细比较,依据化石和现生鱼类的研究结果,将鳜类二属即鳜属和少鳞鳜属的主要区别特征列于表1。

从上述标本特征描述来看,山旺标本鳃盖骨后缘有两扁棘,大小相仿,上边缘隆起为弧形;前鳃盖骨后缘有细锯齿,后下角及下缘的锯齿强壮而不甚规则,呈弱棘状,棘上分布有数目不等的小锯齿;脊椎骨30等特征均是少鳞鳜属区别于鳜属的主要特征,因此,将山旺标本归入少鳞鳜属应该是较适宜的。

中新世鳜类化石材料报道较少,同它们进行详细的比较非常困难。大江文雄等(Ohe and Teruo, 1975, Ohe and Hayata, 1984)分别报道了日本中新世地层中发现的鳜类化石,其中产于瑞浪群(Mizunami Gr.)中村组(Nakamura Fm.)中的 *Coreoperca fushimiensis* 仅保存了躯体部分,特征不明显,难以比较;产于瑞浪群平牧组(Hiramaki Fm.)中的 *Coreoperca kaniensis*,保存也欠完整,主要特征为:体侧扁,头部较尖;齿骨具绒毛状细齿,

表1　少鳞鳜属和鳜属主要特征的比较(部分特征取自刘焕章等, 1994)

Table 1　Comparison between *Coreoperca* and *Siniperca* (some characters from Lin and Chen, 1994)

少鳞鳜属(*Coreoperca*)	鳜属(*Siniperca*)
1　上、下颌、犁骨、腭骨均密布细齿 (villiform teeth on the jaw, vomer and palatine)	上、下颌、犁骨、腭骨均具锥状齿或细齿 (coniform teeth or villiform teeth on the jaw, vomer and palatine)
2　前鳃盖骨后缘具细的锯齿，后下角处至下缘稍扩大或呈弱棘状 (fine serrations on the posterior margin of the preoperculum, slightly enlarged serrations or weak spines on its postventral edge)	前鳃盖骨后缘具细的锯齿，后下角处至下缘有4枚扩大的强棘 (fine serrations on the posterior margin of the preoperculum, four enlarged spines on its postventral edge)
3　背鳍前骨式 0/0/0+1/或 0/0/0+2/ (predorsal formula 0/0/0+1/or 0/0/0+2/)	背鳍前骨式 0/0/0+2/ (predorsal formula 0/0/0+2/)
4　脊椎骨 30～33 (vertebrae 30～33)	脊椎骨28(vertebrae 28)
5　主鳃盖骨上边缘隆起为弧形或平坦 (upper edge of operculum convexed or straight)	主鳃盖骨上边缘平坦 (upper edge of operculum straight)
6　上枕骨骨架同上枕嵴上边缘为深叉状 (supraoccipital shelf and upper border forming a deep fork)	上枕骨骨架同上枕嵴上边缘为浅叉状或愈合(supraoccipital shelf and upper border forming a shallow fork or integrated)
7　侧线鳞34～67(34～67 scales in lateral line)	侧线鳞66～125(66～125 lateral-line scales)
8　幽盲囊3(或2)个(3 or 2 caecal lobules)	幽盲囊5～240个或以上(5 to 240 caecal lobules or more)
9　鳃耙7～16 (7 to 16 gill rakers)	鳃耙4～7 (4 to 7 gill rakers)

无分化的犬齿；背鳍鳍棘部分和鳍条部分连续，背鳍式为 XII, 13；胸鳍条 10 根；臀鳍式为 III, 9；腹鳍式为 I, 5；脊椎骨 28 个(12+16)；背鳍前骨式为 0/0/0+2/；尾鳍后端截形。从脊椎骨 28 个来看，它更象是 *Siniperca*，由于关键特征鳃盖骨系列保存极差，难以与山东少鳞鳜作详细比较，但可以肯定两者是不同的。山东少鳞鳜与现生三种少鳞鳜的区别见表 2。

由于现生低等鲈类相互关系极不明确，选择合适的外类群非常困难。然而，选择不同的外类群时，特征的演化极向可能会截然不同，所得分析结果也会有差异。刘焕章等(1994)曾以花鲈(*Lateolabrax japonicus*)为外类群，对现生鳜类的系统发育关系进行了研究，认为少鳞鳜属

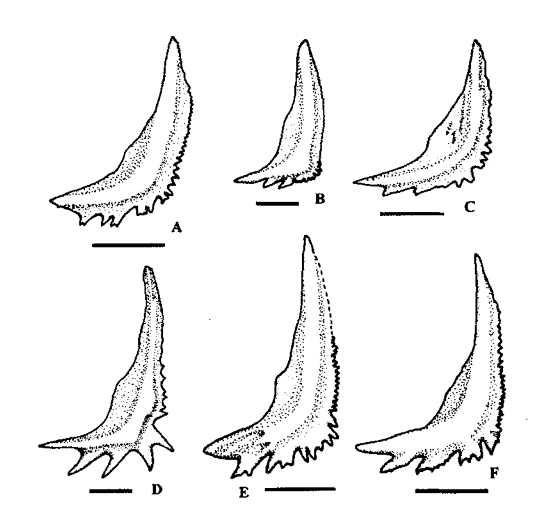


图 10　山东少鳞鳜前鳃盖骨与现生鳜类的比较

Fig. 10 Comparison of the preoperculum between *Coreoperca shandongensis* sp. nov. and other sinipercine fishes　A. *Coreoperca kawamebari;* B. *Coreoperca whiteheadi;* C. *Coreoperca herzi;* D. *Siniperca chuatsi;* E, F. *Coreoperca shandongensis;* scale bars 5mm

表2 山东少鳞鳜与少鳞鳜现生种的比较(现生种特征取自刘焕章等，1994)

Table 2 Comparison between *Coreoperca shandongensis* and extant species of *Coreoperca* (characters of extant species from Liu and Chen, 1994)

属 种 (taxa) / 特征 (characteristic)	山东少鳞鳜 (*Coreoperca shandongensis*)	朝鲜少鳞鳜 (*Coreoperca herzi*)	日本少鳞鳜 (*Coreoperca kawamebari*)	中国少鳞鳜 (*Coreoperca whiteheadi*)
背鳍式 (dorsal fin rays)	XII，13	XIII，13	XI–XII，12～13	XII–XV，12～16
背鳍前骨式 (predorsal formula)	0/0/0+2/	0/0/0+2/	0/0/0+1/	0/0/0+1/
臀鳍式 (anal fin rays)	III，9～10	III，9	III，10	III，10～12
胸鳍条 (pectoral fin rays)	13～16	12～13	13～14	13～15
腹鳍式 (pelvic fin rays)	I，5	I，5	I，5	I，5
脊椎骨 (vertebrae)	30	32	30	33
前鳃盖骨后下角扩大棘 (large spines on posteroventral edge of preoperculum)	不显著 (not obvious)	不显著 (not obvious)	无(absent with many small serrations)	无(absent with many small serrations)
主鳃盖骨上边缘形态 (upper edge of operculum)	隆起为弧形 (convex)	平坦 (straight)	隆起为弧形 (convex)	平坦 (straight)
间鳃盖骨下表面及边缘 (lower face of interoperculum)	有细的粗糙突起 (coarse)	无细的粗糙突起 (not coarse)	有细的粗糙突起 (coarse)	有细的粗糙突起 (coarse)
间鳃盖骨下边缘锯齿 (serrations on lower edge of interoperculum)	有 (present)	无 (absent)	无 (absent)	无 (absent)
下鳃盖骨下边缘锯齿 (serrations on lower edge of suboperculum)	有 (present)	无 (absent)	无 (absent)	有 (present)
匙骨后缘锯齿(serrations on posterior margin of cleithrum)	无 (absent)	无 (absent)	无 (absent)	有 (present)
角舌骨上边缘(upper edge of ceratohyal)	金眼鲷孔 (with a berycoid foramen)	凹陷为缺刻 (with a notch)	凹陷为缺刻 (with a notch)	凹陷为缺刻 (with a notch)

与鳜属为姐妹群关系，其中现生三种少鳞鳜之间的关系又以中国少鳞鳜与日本少鳞鳜之间的关系更近。本文如果将鳜属作外类群对少鳞鳜属的特征进行分析比较，结果就会发现山东少鳞鳜所具有的特征多为祖征状态或较原始的状态，如顶骨宽大于长，呈近不等边梯形；前鳃盖骨后下角及下缘的锯齿强壮而不规则(图 10)；背鳍前骨式为 0/0/0+2/；间鳃盖骨、下鳃盖骨的下边缘有锯齿；椎骨 30 个等。其中顶骨近不等边梯形，长大于宽，是现生鳜属中常见的特征，而现生少鳞鳜属的顶骨则通常为细长的三角形，宽大于长，山东少鳞鳜的顶骨特征恰好介于鳜属和少鳞鳜属两者之间。因此，山东少鳞鳜可能是少鳞鳜属中最原始的种类。

从以上描述和比较可以看出，山东少鳞鳜已区别于所有已知的现生种和化石种，同时又表现出鳜类早期物种分化时的一些原始特征，因此，可以认为山东少鳞鳜是少鳞鳜属中的较原始代表，已构成了一化石新种，故命名为山东少鳞鳜(*Coreoperca shandongensis* sp. nov.)。

3　动物地理学意义

鳜类是东亚特有的淡水鱼类，现生种类主要分布于中国、朝鲜、日本和越南。其中现生中国少鳞鳜从云南南部、广西、广东、海南、贵州、湖南、至浙江断断续续皆有分布，并扩及越南北方；朝鲜少鳞鳜仅分布于朝鲜半岛北部和西部水体中，日本少鳞鳜分布于日本本州中部以南及朝鲜半岛南端的长兴和晋州(Zhou *et al.*, 1988)。

鳜类化石的报道却非常零星，目前仅有我国山西榆社上新世的武乡鳜(*Siniperca wusiangensis* Liu and Su, 1962)和前面提到的产于日本岐阜县中新世瑞浪群平牧组和中村组的 *Coreoperca kaniensis* 和 *Coreoperca fushimiensis*(Oheo and Teruo, 1975, Ohe and Hayata, 1984)，此外还有日本九州对马海峡中的壹岐岛(Iki Island)时代尚有争议(上新世或中新世)的长者原硅藻土组(Chojabaru Fm.)中的 *Siniperca* 和 *Coreoperca* 化石材料(Hayashi, 1975)。山东少鳞鳜的发现，不仅为山旺鱼类动物群增添了新成员，而且也说明原始鳜类在早中新世已发生分化，上新世时期已分化出较高等的武乡鳜，少鳞鳜属并非起源于朝鲜和日本一带，在中新世时期中国大陆也已相当繁盛，中国少鳞鳜更不是由朝鲜和日本一带扩散到中国来的。

新生代晚期东亚淡水鱼类区系演替的初步研究结果(Chang *et al.*, 1996)已表明，在中新世和上新世时期中国东部和日本同属一个鱼类区系，在中新世(以山东山旺为主要代表)这个区系与当今东亚淡水鱼类区系很不相同，绝大部分种类均非现生属，更没有现生种，以鲤科鱼类为主，其中又以鲤亚科、雅罗鱼亚科和鲴亚科鱼类占主导地位。鳜类化石在日本中新世地层早已有报道，且现生淡水鱼类中仍有少鳞鳜繁衍生息，中新世山旺山东少鳞鳜的发现可以进一步说明和支持以上关于中国东部和日本列岛新生代晚期同属一个鱼类区系的观点。

现生的鳜类中，鳜属中较进化的种类如 *Siniperca chuatsi*, *Siniperca kneri*, *Siniperca scherzeri* 等主要生活于大江大河及大的湖泊环境中，且一般于流水中产卵，而少鳞鳜属和鳜属中较原始的种类如 *Siniperca obscura* 等主要生活在大江大河的支流或相对小的水体

中。山东鳜的发现可以进一步说明中新世山旺盆地沉积时期为一气候温暖的小水体环境。晚第三纪以来化石及现生鳜类所表现出的这种演化特点和生活环境的变化与鲴亚科及其他鲤科鱼类所反映的演化规律是相一致的，共同反映了中新世时期中国东部及日本为气候温暖的小水体环境，上新世伴随着大江大河的出现，出现了现生的属、种。在日本，由于大江、大河的环境于上新世之后消失，这一区系为现代的鱼类区系所取代，而在中国东部则一直延续了下来。由于能生活于相对小的水体环境，鮈亚科、少鳞鳜属的种类至今仍被保留于日本的现生鱼类区系中。

致谢 本文写作过程中始终得到了张弥曼教授的指导和帮助；在与周家健等鱼室诸位先生的多次讨论中获得了有关古鱼类学研究的许多宝贵经验和技巧；野外工作期间得到了山旺古生物化石保护管理所和山东临朐县矽土矿厂的大力协助；张宏先生协助采集化石；张杰先生为本文制作了精美的图版，张江永先生拍摄显微相片，在此一并致谢。

DISCOVERY OF FOSSIL *COREOPERCA* (PERCIFORMES) IN CHINA

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Key words Shandong, Shanwang, late Early Miocene, Perciformes, *Coreoperca*

Summary

Sinipercine is a group of freshwater perciform fishes distributed only in East Asia. Its affinity and geological history have been little known for the paucity of the fossils available. The only previously known fossils are *Siniperca wusiangensis* from the Pliocene deposits of Shanxi, China, and *Coreoperca kaniensis* and other sinipercine materials from the Miocene formation of Japan. The specimens described in this paper were collected by the senior author from the Miocene Shanwang Formation, Shandong, eastern China during an intensive excavation in 1996. This paper presents a full description of the new material and discussion about problems related to its systematics and distribution.

All specimens are stored in IVPP under the catalogue numbers V 11523.1～18.

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Superorder Percomorpha Rosen, 1973
Order Perciformes Regan, 1913
Suborder and family indet.
***Coreoperca* Herzenstein, 1896**
***Coreoperca shandongensis* sp.nov.**
(figs. 1～10; pls. I～III)

Diagnosis Moderate-sized fish with known standard length between 104 to 115mm; predorsal formula 0/0/0+2/; dorsal fin XII, 13; pelvic fin with 13～16 soft rays; anal fin with 9 soft rays but in few specimens with 10; posterior margin of cleithrum smooth; upper edge of ceratohyal with berycoid foramen; opercular with two spines about same size, its upper edge convex; posteroventral edge of preopercular with strong irregular spines, some of which bifurcated; lower edges of both interopercular and subopercular serrated; lower face of interopercular coarse; vertebrae 30.

Holotype A nearly complete fish with the posterior portion of its caudal fin missing, catalogue number of IVPP: V 11523.1.

Referred specimens Two complete individuals but with some bones damaged (IVPP V 11523.2～3), fifteen specimens of fish remains or disarticulated bones (IVPP V 11523.4～18).

Locality and horizon Linqu County, Shandong Province; Shanwang Formation, late Early Miocene.

Etymology shandong-name of a province of China, where the fossil was discovered.

Description Moderate-sized fish with slightly compressed body, mouth large, head length 1.3～1.4 times of head depth. The standard length from 3 complete individuals is about 104～115mm, about 2.5～2.6 times head length, 2.9～3.0 body depth. The maximum depth is at dorsal fin origin or slightly posterior.

The cranial roof in V 11523.9～10 is smooth, most of which occupied by two large wide frontals. The supraorbital sensory canal is partly bone enclosed, passing through anterior part to posterolateral part of the frontal. The parietal is small, trapezoid, forming a flat surface with the frontals and lateral parts of supraoccipitals. The length of parietal is less than its width. The anterior part of the supraoccipital slightly separates the frontals posteriorly. The strong supraoccipital crest can be observed in V 11523.11, but it is not clear if the supraoccipital shelf and upper border are integrated or formed a fork shape. The orbital cavity is large, the diameter of which is slightly less than preorbital distance. The robust parasphenoid passes through the orbital cavity. There is a process in the mid-ventral side of the sphenotic connected with the hyomandibular. The posterior margin of the posttemporal is

smooth.

The mouth gape is large. The articulation of the articular and the quadrate is behind the orbit. Premaxilla and dentary border the jaw margin. The ventral border of the premaxilla bears villiform teeth. The slightly arc-like maxilla is wide and flat posteriorly and narrow anteriorly. The supramaxilla is small and elongate, attached on the posterodorsal border of the maxilla in V 11523.5. The thick dentary is approximately triangular in shape, bearing villiform teeth on its upper border. Two small angulars are present at the posteroventral margin of the articular.

A fine rod-like bone with villiform teeth under the ectopterygoid in V 11523.12 is thought to be the palatine. The entopterygoid is oblong in shape, and its dorsal part almost reaches the parasphenoid. The ectopterygoid is arc-like in shape, connected with the entopterygoid dorsally and the quadrate posteriorly. the quadrate is triangular, articulated with the articular. Its posterior process is thick and short.

The opercular is slightly trapezoid, the anterior edge of which is thickened. It presents two about the same-sized spines on the posterior margin. Its upper edge is convex rather than straight as most sinipercine show. The preopercular is strongly serrated, and its posteroventral edge bears irregular spines, some of which are bifurcated. The upper limb of the preopercular is much longer than the lower one, forming an angle of about 90°. The subopercular is slightly serrated. The interopercular is oval in shape with a serrated ventral margin.

The basihyal in V 11523.16 is very clear, and the epihyal, ceratohyal and interhyal can be observed is V 11523.5. The epihyal is triangular, widens anteriorly. The ceratohyal is long and flat, and its anterior and posterior parts are wider than the median part. There is a berycoid foramen near its upper edge in V 11523.10. There are 7 branchiostegals.

Girdle and fin The supracleithrum is spoon-like in V 11523.3. The cleithrum is strong and its postdorsal border is smooth. The first postcleithrum is scale-like, the second one elongate. The upper three radials are articulated with the scapula and the forth partly with the scapula and partly with the coracoid. There are 13 to 15(16?) pectoral rays. The origin of pectoral fin is opposite to that of the dorsal fin.

The origin of the pelvic fin is a little behind that of the pectoral fin and dorsal fin. There is a long strong spine and 5 soft rays attached to the innominatum. The postpelvic process is long and partly fused with each other.

The base of the dorsal fin is long and consists of two parts. The spinous part has 12 spines. The first spine is shortest, the 7th and 6th longest, the last spine about as long as the 4th. There are 3 predorsal bones and its formula is 0/0/0+2/. The soft ray part has 13 soft rays. The pterygiophores of the soft rays are much weaker as compared with those of the spines. The anal fin has 3 spines and 9 to 10 soft rays.

The origin of the anal fin is slightly posterior to the origin of the dorsal soft ray part. The first anal spine is short and small, the second longest and strongest. The first pterygiophore showes the vestige of two fused pterygiophores and supports two spines, reaching near to the first caudal vertebrae.

According to V 11523.2～3 and V 11523.5, the end of the caudal fin is round. The formula of principal caudal rays is I, 8, 7, I. There are 8 procurrent rays on each side of the principal caudal fin rays.

Vertebral column There are 30 vertebrae(13 abdominals and 17 caudals. Two pairs of epineurals in the first two abdominal vertebrae, and 11 pairs of long pleural ribs of which all but the last three are with fine unforked epipleurals. The last three abdominal vertebrae have obvious parapophyses. The caudal skeleton is very common in lower perciforms, which is preserved very well in V 11523.17. The first preural centrum is fused with the first ural centrum, forming a triangular compound centrum. There are 2 uroneurals, 3 epurals and 5 hypurals. The posterior end of uroneural 1 is extended to be stegural, uroneural 2 is small and thin. Hypural 1～4 are wide and flat, hypural 5 is the smallest. The hypurapophysis is well developed. The second preural haemal spine is wider than the third preural haemal spine.

We only observed a few small fine cycloid scales covered the cleithrum and some part of the body in V 11523.13.

Comparison and discussion Since Temminck and Schlegel established a sinipercine species "*Serranus kawamebari*" in "Pisces, Siebold's Fauna Japonica" in 1842, many new species have been described, referred to *Siniperca*, *Coreoperca* and *Coreosiniperca* respectively. The distinctions between the genera are not very clear. The latest phylogenetic analysis on the extant sinipercine (Liu and Chen, 1994) confirmed two valid genera(*Siniperca* and *Coreperca*). Based on our recent observations on both fossil and extant specimens, the main characters to distinguish them are summarized in table 1.

As described above, *Coreoperca shandongensis* sp. nov. is characterized by the posterior margin of the opercular with two approximately same sized spines and the upper edge of the opercular convex; the posteroventral edge of the preopercular with irregular strong spines, some of which bifurcated; the lower edges of the interopercular and subopercular serrated; the dorsal fin rays XII, 13; the predorsal formula 0/0/0+2/ and vertebrae 30. It differs from all extant species of *Coreoperca* (see table 2), representing a new species. The discovery leads to the conclusion that the sinipercine differentiated early in Miocene and become very prosperous not only in Japan but also in China, and further supporting the suggestion that the fish faunas in eastern China and Japan belonged to the same one during Late Cenozoic. It is probably not the case that the sinipercine was originated in Japan and Korea in Early

Miocene then migrated to China.

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图版说明(Explanations of plates)

图版 I (Plate I)

山东少鳞鳜 *Coreoperca shandongensis* sp. nov.

1 近完整个体,左侧视 a nearly complete individual in left lateral view, V 11523.1, ×1.5

2 完整个体,右侧视 a complete individual in right lateral view, V 11523.17, ×1.6

图版II (Plate II)

山东少鳞鳜 *Coreoperca shandongensis* sp. nov.

1 不完整个体,左侧视,示背鳍鳍棘和背鳍前骨 an incomplete individual in left lateral view, showing the dorsal spines and predorsal bones, V 11523.9, ×2

2 近完整个体, 右侧视, 示臀鳍式 a nearly complete individual in right lateral view, showing the anal fin, V 11523.7, ×1

3 不完整个体,右侧视,示背鳍和腹鳍 an incomplete individual in right lateral view, showing the dorsal fin and

pelvic fin, V 11523.4, ×1

图版 III (Plate III)

山东少鳞鳜 *Coreoperca shandongensis* sp.nov. ×2

1 头部骨片，背侧视 part of skull skeleton in dorso-lateral view, V 11523.8
2 左关节骨和隅骨，侧视 lateral view of left articular and angulars, V 11523.6
3 右齿骨，侧视 lateral view of right dentary, V 11523.10
4 右方骨和续骨，侧视 lateral view of right quadrate and symplectic, V 11523.10
5 尾部，右侧视，示尾骨骼和尾鳍 the posterior part of the body in right lateral view, showing the caudal fin and skeleton, V 11523.3
6 左辅上颌骨和上颌骨，舌侧视 lingual view of left maxilla and supramaxilla, V 11523.5
7 右前上颌骨，侧视 lateral view of right premaxilla, V 11523.10

消　息

第 15 届 HKT 会议将于 2000 年 4 月在成都召开

由于青藏高原特殊的地理、地质条件以及对全球资源和环境产生的重大影响，所以自1985 年国际上召开首届喜马拉雅—喀喇昆仑—西藏学术讨论会 (Himalaya—Karakoram—Tibet Workshop，简称 HKT 会议) 以来，迄今已经在英国、法国、瑞士、意大利、奥地利、尼泊尔、美国、巴基斯坦、德国等国家连续召开了 14 届。经我国科学家积极争取，第 14 届 HKT 会议组委会于 1999 年 3 月 27 日讨论决定，第 15 届 HKT 会议定于 2000 年 4 月 21～24 日在中国成都举行。

青藏高原绝大部分位于我国境内，是我国地学界的一块瑰宝，也是我国地球科学研究中最有希望占领"一席之地"的领域。HKT 会议学术内容涵盖地质、地球化学、地球物理等诸多领域，并朝着建立地球系统科学新理论的方向发展。第 15 届 HKT 会议，将会为展示我国在这一领域取得的丰硕科学研究成果提供重要契机，并将进一步推动我国对青藏高原的科学研究工作。

这次会议将由国家科技部和国土资源部联合主办。支持单位有：中国国家自然科学基金委员会，中国科学院，中国国家地震局，中国地质学会，中国青藏高原研究会，国际地科联岩石圈委员会，四川省科学技术委员会，油气藏地质与开发工程国家重点实验室。成都理工学院、中国地质大学、中国地质科学院具体负责这次会议的承办工作。会议筹备秘书处办公室设在成都理工学院科技与外事处。

这次会议的第 1 号通知 (国内)，将于今年 6 月下旬发出。

会议联系人：邓斌　杨桂和　杨慧东

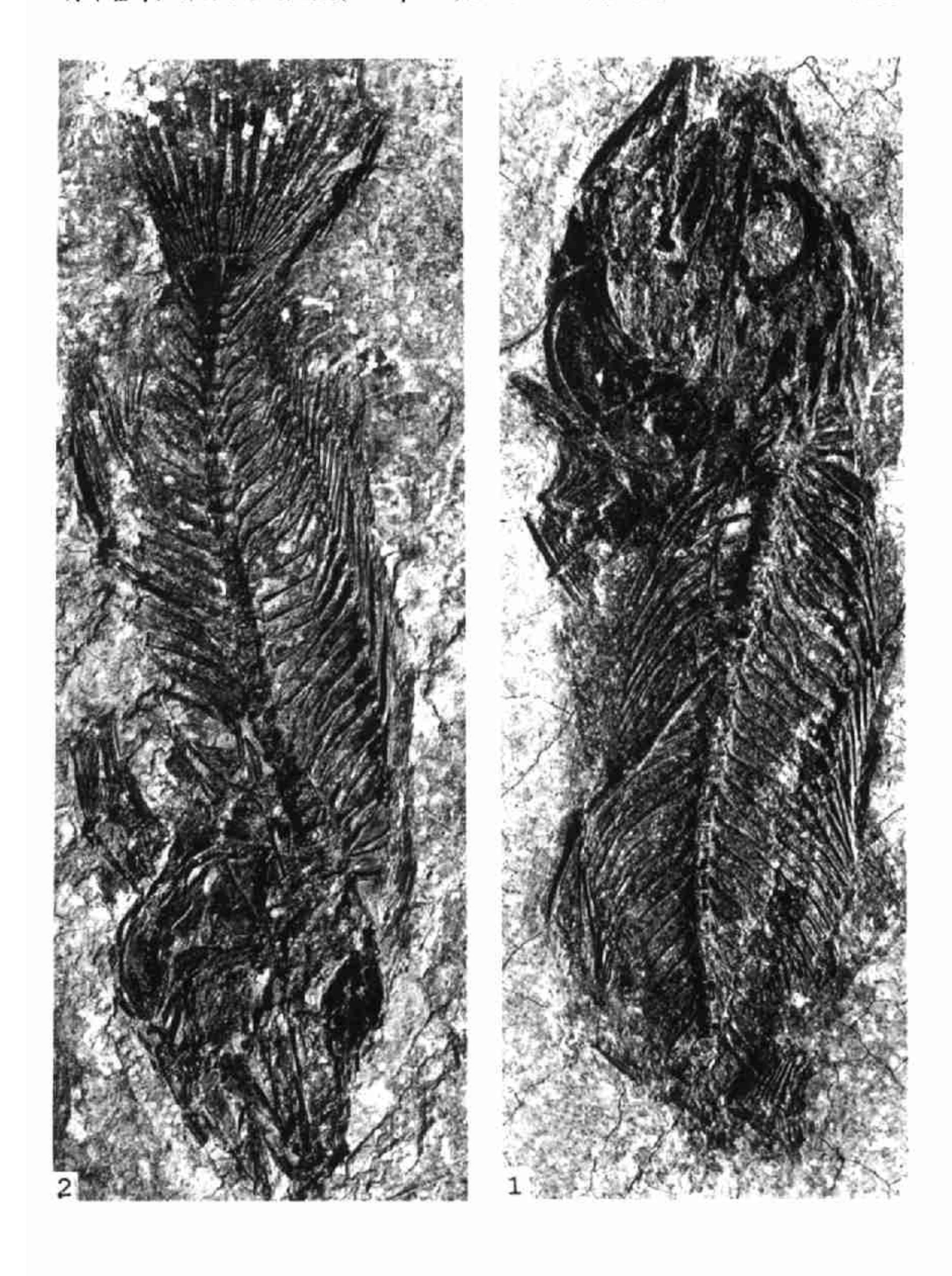
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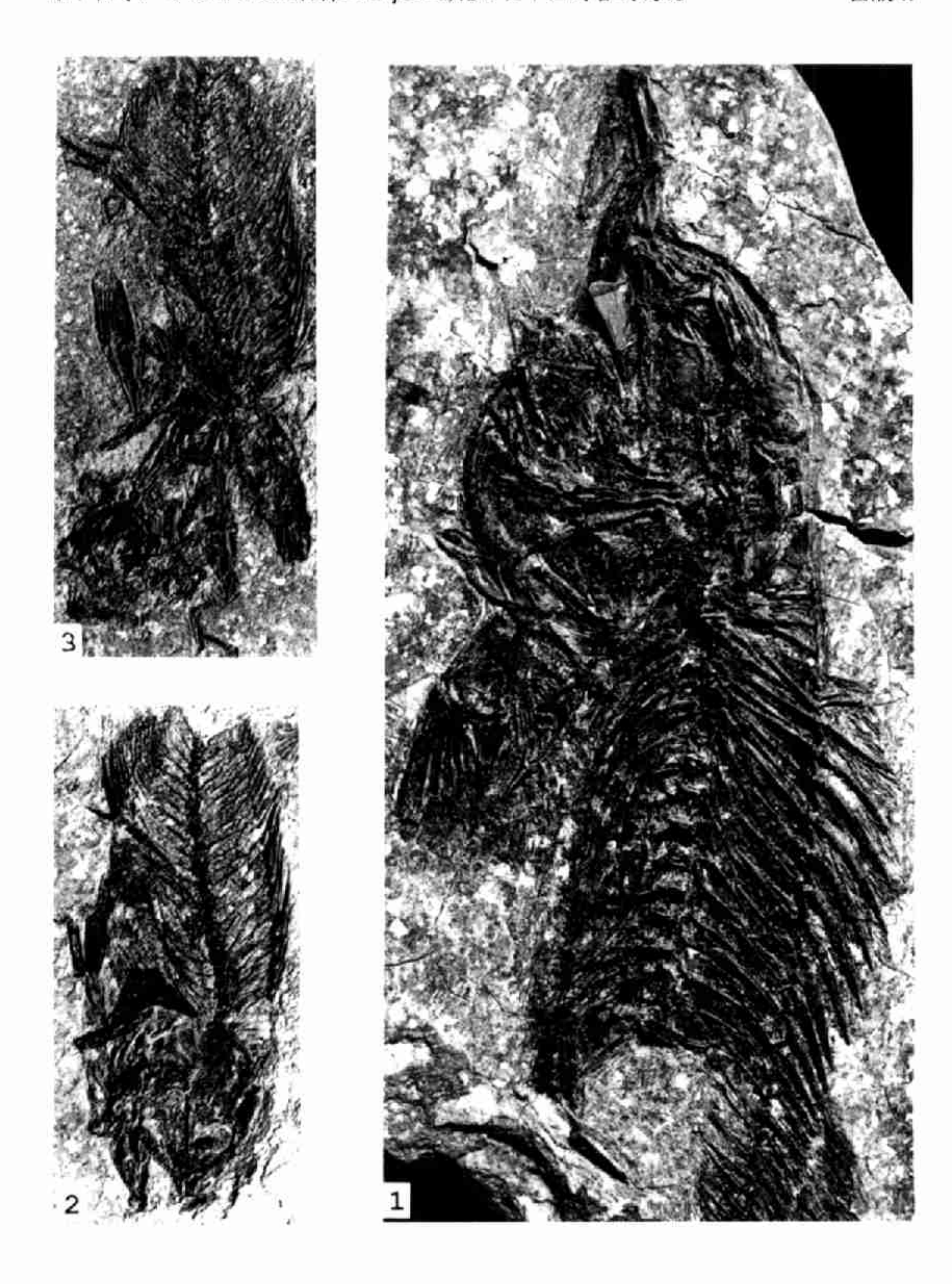
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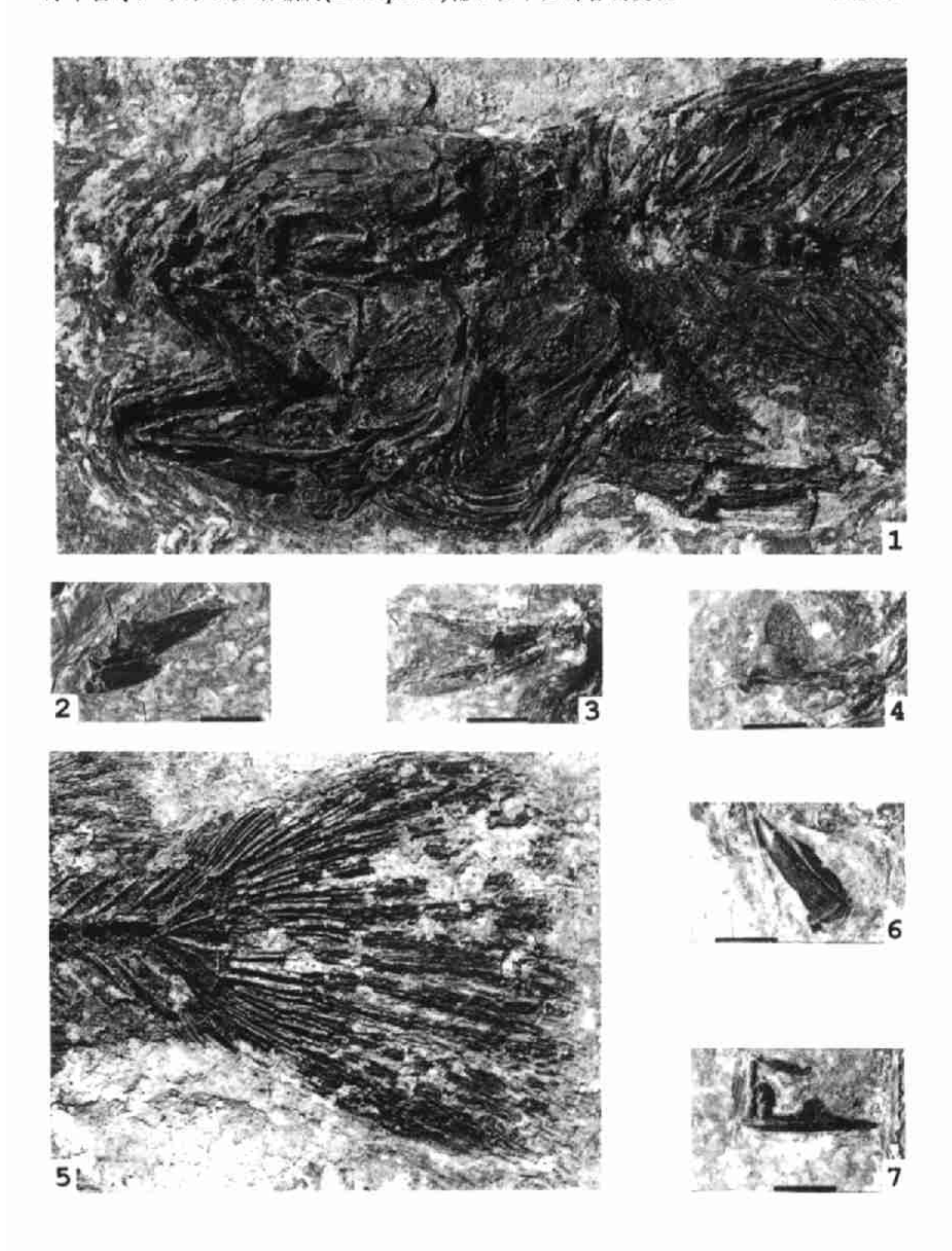
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